GOTRA PROJECT,

KARAULI STATE.

1907.

Estimate framed by Mr. F. St. G. Manners-Smith, Superintending Engineer, of the expense of the Gotra Tank Project in the Karauli State.

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GOTRA PROJECT.

KARAULI STATE.

References.—

See Project No. 2, Topographical Survey, Sheet No. 42, on page 31, Irrigation Report, Karauli State.

Project No. 16, Appendix D., page 83, Irrigation Report, Karauli State.

Project No. 38, page 149, Irrigation Report, Karauli State.

Note by Mr. Gatherer, Superintending Engineer, page 115, Irrigation Report, Karauli State.

Note by Major Gordon Cumming, Superintending Engineer, page 125, Irrigation Report, Karauli State.

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(*d*) Constructing irrigation channels to irrigate—

(1) The Sapotra valley from the Main sluice in Dam B.

(2) A small area of land on north-west of Main Dam.

II. The site in an excellent one for a Dam, and the whole of the Sapotra valley is available for irrigation, as at present it is only cultivated with rain crops; and the flood water of the river flows away each year, and is lost to the State, when it might be stored for its profit, and for that of its cultivators.

It is over 20 years since the project was first favourably reported on, but nothing has yet been done. It is hoped that no further time will be lost (for each year deferred, means money lost to the State) and that the question of funds for the work and its early execution may be seriously considered.

III. *Average rainfall and Catchment area.*—The average rainfall as recorded at Sapotra for the last 16 years works out to 25·6 inches, as noted in the margin. The catchment area is 16 square miles, and as it is partly hilly we can estimate on 15 % of the average rainfall as available for storage or

Years.	Inches.
1891	23·63
1892	26·56
1893	28·16
1894	45·48
1895	20·17
1896	19·59
1897	26·06
1898	19·76
1899	22·37
1900	27·21
1901	23·91
1902	36·38
1903	30·50
1904	34·58
1905	6·88
1906	20·43
Total....	409·70
Average	25·6

m. c. ft.		Rainfall.		Sq. miles.		m.c.ft.
$2\frac{1}{3}$	×	$\frac{25\cdot6}{6\cdot6}$	×	16	=	$145\cdot8$

From Major Cumming's Note on the project, it appears that Mr. Housden calculated the catchment area as 20 square miles, but this is incorrect; also the Ogha is referred to as a perennial stream, calculated to supply an additional 126 m. c.ft. of water. The series of years of deficient rainfall, that have occurred since that report was written, have altered this, and no water now flows in the stream except during the floods in the rains.

IV. *Capacity.*—The following table gives the water-spread and capacity of the proposed tank at the different contours. The bed of the Ogha Nullah at site of Dam has been taken as R. L. 200 :—

R. L.	Water-spread in square feet.	Capacity of each contour in m. c.ft. $Q=(A+a+\sqrt{A+a})$	Total Capacity.
			m.c.ft.
250	26,100,000		477·69
		122·83	
245	23,100,000		354·86
		107·12	
240	19,790,000		247·74
		87·10	
235	15,150,000		160·64
		14·49	
234	14,492,000		146·15
		50·54	
230	10,860,000		95·61
		46·50	
225	7,200,000		49·11
		27·22	
220	3,860,000		21·89
		14·18	
215	1,950,000		7·71
		5·72	
210	510,000		1·99
		1·66	
205	180,000		·33
		·33	
200	0		0

With weir-level R.L. 234, the Tank will have a capacity of 146 m. c.ft., the quantity estimated as available for storage on the average rainfall.

V. *Maximum discharge and Length of weir.*—The maximum discharge for the 16 sq. miles of catchment area by Dicken's formula is 6,600 cusecs; and a weir 367 r. ft: in length will discharge this with a 3 ft. head, and has been provided.

The weir will be in two lengths, *viz.*, 110 r.ft. in the gap between the hills, north of the Main Dam; and 260 r.ft. cut out of the rocky hill at north end of sudsidiary Dam.

VI. *Dam.*—Dam with weir-level, R. L. 234, the crest of Dam will be 240, or 6 ft. above weir and 3 ft. above flood-level.

(*a*) The Main Dam across the Ogha Nullah will be 250 r.ft. in length, and have a masonry face-wall backed with earth.

The R. L. of top of face-wall is 238 or 1 foot above flood-level, the top width 2 feet, front batter of 1 in 12, and rear faced stepped off with 6″ offsets for every 2½ feet depth so that the breadth at any point is $\frac{H}{3}$.

The R. L. of top of earth backing is R. L. 240 with a top width of 10 feet, front slope of 3 to 1, and rear slope of 2 to 1.

(*b*) The long subsidiary Dam has a total length of 3,380 r.ft., and consists of an earthen Dam with concrete core-wall. Concrete is as good as masonry for the purpose and cheaper, and has this advantage also that it can be executed by unskilled labour, and is therefore suitable for a famine relief work. Starting at the north end (from the wing wall at south end of the weir, cut out of the rocky hill) the Dam runs in a south-west direction to reach natural high ground, which it then follows from west to east. The crest of core-wall is R. L. 238 or 1 foot above flood-level, and the wall has a top width of 2 feet, with 6″ offset at every 4 feet, *i.e.* 3″ on either side. The foundations of the core-wall are taken down to firm soil. The earthwork in front of core-wall forms a terrace 5 feet in width, with front slope of 3 to 1, and is pitched to protect it from wave action.

The top of Dam is R. L. 240, and is 10 feet wide, with a 3 to 1 front slope down to the core-wall, and a rear slope of 2 to 1

VII. *Sluices.*—Two Sluices have been provided.—

(*a*) Sluice No. 1 in the Main Dam with sill-level, R. L. 210.

(*b*) Sluice No. 2 in the Subsidiary Dam with sill-level, R. L. 220.

Nearly all the irrigation will be from Sluice No. 2 which commands 1,534 acres in the Sapotra Valley. Sluice No. 1 only commands 500 acres.

Sluice No. 2.—The water available for irrigation from Sluice No. 2 is—

M.c.ft.	
146·15	capacity at weir-level.
—27·22	„ „ R. L. 220 sill-level,
118·93	

which is sufficient for 1,190 acres, allowing 1,00,000 c.ft. per acre, inclusive of absorption and evaporation.

As the demand for irrigation is simultaneous, the Sluice should be able to give a first watering of 9″ to the whole of this area in the first month, with daily flow of 12 hours

$$D = \frac{\overset{\text{Acres.}}{1{,}190} \times \overset{\text{S.ft.}}{43{,}560} \times \frac{3}{4}}{30 \times 12 \times 60 \times 60} = \frac{39{,}027{,}300}{1{,}296{,}000} = 30{\cdot}26 \text{ cusecs.}$$

The quantity discharged in the first month will be 39·03 m. c.ft., leaving 118·93—39·03=79·90 m. c.ft. to be discharged by continuous flow in the next three months of Rabi season or

$$D = \frac{\overset{\text{M.c.ft.}}{79{\cdot}90}}{3 \times 2{\cdot}592 \text{ (secs per month)}} = 10{\cdot}27 \text{ Cusecs}$$

A 1½ ft. diameter pipe will discharge 10·4 cusecs with 1 ft. head, and with mean head of 7 feet 44 cusecs; so will satisfy requirements.

Sluice No. I.—For this Sluice the total water available when tank is full is 146·15 m. c.ft.—5·72=140·43 m. c.ft. But Sluice No. 2 has taken 119 m. c.ft. of this, so that only 21 m. c.ft. of water remains, sufficient for 210 acres. To give a first watering of 9″ in the first month to the whole of this area the Sluice must discharge

$$D = \frac{\overset{\text{Acres.}}{210} \times \overset{\text{S.ft.}}{43{,}560} \times \frac{3}{4}}{1{,}296{,}000} = \frac{9{,}147{,}600}{1{,}296{,}000} = 7 \text{ Cusecs, and the balance in}$$

the remaining 3 months

$$D = \frac{\overset{\text{M. c.ft.}}{21 - 9{\cdot}15}}{3 \times 2{\cdot}592} = 1{\cdot}2 \text{ Cusecs and a 9″ diameter pipe will satisfy these}$$

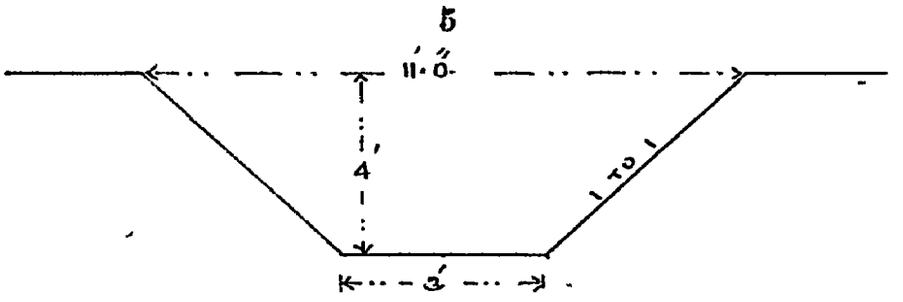
requirements.

VIII. *Design for Sluices.*—The Sluices are similar in design, and consist of a Circular Sluice well in front of the Core-wall or Face-wall with a 2 feet opening up the face, across which stone slabs are fixed, perforated with 3″ openings, through which the water enters the chamber. For 9 feet in front of this the wing walls are built parallel to each other and 3 feet apart, forming an outer Chamber. Cut stone grooves, 2 feet apart, are provided, into which planks can be placed, and earth rammed between to shut off the water at any time, so that the Sluice can be examined and repaired if necessary.

An iron grating with vertical bars is also provided to prevent brushwood, or anything likely to block the pipe or valve, passing into the sluice well. Beyond this in Sluice No. 2 the wing wall splays out till the toe of the front slope is reached.

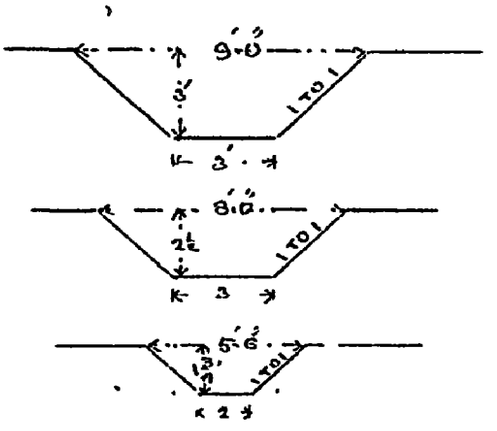
The sluice valve is in the Sluice Chamber, and is opened by a vertical rod with screwed head, the screw wheel at the top showing clearly how much the valve is open at any time. When the sluice is open the water passes into a masonry arched drain under the rear slope of the earthen Dam, connected with the Irrigation Channels.

IX. *Irrigation Channels.*—The line for the Irrigation Channels has been set out down the Sapotra Valley from Sluice No. 2 with a fall of 1 foot per mile (See plan No. I). To discharge the maximum required of 30·26 cusecs the channel must start with a section of



and for Channels 1, 2 and 3 as noted below :—

	Area commanded.	Water sufficient for	Discharge to Irrigate area with 9" watering in 30 days 12 hours' flow.	Section.
	Acres.	Acres.	Cusecs.	
Channel No. 1	727	600	15	
Channel No. 2	600	500	12·6	
Channel No. 3	207	190	4·7	



The section of channel for sluice No. 1, which commands 200 acres, will be the same as that for No. 3 above.

X. *Abstract estimate of cost.*—The following is the Abstract Estimate of the cost of the Project :—

	Rs.	Rs.
Dam No. 1	14,799	
Dam No. 2	28,542	
		43,341
Weir No. 1	940	
Weir No. 2	25,166	
		26,106
Sluice No. 1	1,688	
Sluice No. 2	2,087	
		3,775
Irrigation Channel No. 1 ...	536	
Irrigation Channel No. 2 ...	2,635	
		3,171
Contingencies... ...		3,820
		80,213

XI. *Value of water stored.*—The value of water stored is 1,822 c.ft. per rupee, so it is an expensive Project. Supposing the whole 1,190 acres from Sluice No. 2 and 210 acres from Sluice No. 1 are irrigated at Rs. 4 per acre, a revenue of Rs. 5,600 should be realised, and to this may be added $\frac{1}{4}$ of the area of bed of tank or $\frac{36,23,000}{43,560}$ s.ft.=83 acres, at Rs. 2 per acre=Rs. 166, or a total revenue of Rs. 5,766, giving a profit of over 7 per cent. on the estimated cost.

But it will be seen from the rainfall return in paragraph 3 above, that in 8 out of the 16 years recorded, the rainfall exceeded the average of 25·6″ (accepted in working out this Project) and in some years very considerably, so that if experience shows that the Tank fills easily, it would be worthwhile, as there is more land available than can be irrigated by the Tank with its present capacity, to arrange for shutters 1 foot in height on the crest of weir, to enable an extra foot in depth of water to be stored when the heavy floods had passed. This corresponds to an additional 14·5 m.c.ft. sufficient to irrigate 145 acres, which would increase the revenue also by Rs. 580 per annum.

SPECIFICATION.

Dimensions.—All dimensions and measurements of the work are given in the plans and estimate, and are to be strictly adhered to.

Marking out.—The centre line and slopes of Dam to be marked out with trenches 1 ft. deep and 1 ft. broad, showing permanently the inner and outer slopes and the breadth of the top of embankment.

Earthwork.—Before any new earthwork is begun, the old surface to be carefully loosened with pickaxes for a depth of 9 inches, and all roots, bushes, and grass removed. The new earth to be then carried out in layers, not exceeding 9 inches in thickness, carefully consolidated. All the layers to be laid concave, that is lower in the centre, and to be brought up simultaneously with the core-wall. No clods of earth should on any account be allowed in the embankment; no earth to be excavated within 200 ft. of toe of front slope and none from rear of Dam.

Pitching.—The surface of the inner slopes, with the terrace on top, to be protected by a layer of dry rubble stone, 9 inches thick, on 3 inches of chips or kunkar.

Masonry.—The masonry of face-wall, core-wall, sluices, weir, etc., to be of rubble stone set in lime mortar; only hard and durable stones to be used, and the masonry to be kept wet during construction. All the stones to be hammer-dressed and to break joint in the same as well as in the successive courses.

All stones are to be laid on their natural beds; where there is batter the beds of the stones are to be filled in with smaller ones completely embedded in mortar. No empty hollow to be be left, nor spaces filled wholly with mortar or rubbish where pieces of stones ought to have been inserted. The faces of the masonry in contact with the earth to be left quite rough, and those remaining exposed to be smoothed and pointed with lime mortar.

Concrete.—The concrete to consits of 3 parts broken stones to 1 part lime mortar, well mixed together before putting in foundation, and to be laid in 6 inch layers, and well rammed.

Lime Mortar.—The lime to be of good hard kunker burnt in wood fuel; the mortar to consist of 1 part lime to 1½ parts clean sand or surkee.

ESTIMATE.

Detail of work.	No.	Measurements. L.	B.	H.	Quantities.	
I.—DAM.						
(A) Dam No. 1.						
(*a*) *Face-wall.*						
Rock-cutting for foundation.—						
From chain No. 930 to 1070	1	140	$\frac{13+3}{2}$	5	5,600	
1070 to 1160	1	90	13	8	9,360	
1160 to 1245	1	85	$\frac{13+3}{2}$	5	3,600	
						1,860 c.ft.
Concrete in foundation.—						
From chain No. 1036 to 1176	1	140	13	5	9,100	
						9,100 c.ft.
Masonry stone in lime.—						
Foundation	1	140	13	3	5,460	
Superstructure 930 to 1245	1	$\frac{315+140}{2}$	$\frac{3+12\frac{1}{2}}{2}$	38	66,999	
						72,459 c.ft.
Removing silt and boulders from the bed of Nullah at rear side.	1	140	85	2	23,800	
						23,800 c.ft.
(*b*) *Earthwork.*						
From chain No. 950 to 1070	1	120	$\frac{10+2291}{2}$		1,38,060	
1070 to 1160	1	90	2291		2,06,190	
1160 to 1210	1	50	$\frac{2291+10}{2}$		57,525	
					4,01,775	
Deduct.—						
Sluice No. 1.	1	70	6	$3\frac{1}{2}$	1,470	
						4,00,305 c.ft.
(B) Dam No. 2.						
(*a*) *Core-wall.*						
Rock-cutting for foundation.—						
From chain No. 2470 to 2770	1	300	$\frac{2\frac{1}{2}+6\frac{1}{2}}{2}$	4	5,400	
						5,400 c.ft.
Concrete in foundation.—						
From chainage No. 2770 to 2970	1	200	$6\frac{1}{2}$	3	3,900	
2960 to 2971	1	10	6	2	120	
2970 to 3120	1	150	6	3	2,700	
3132 to 3270	1	150	$4\frac{1}{2}$	3	2,025	
3270 to 3460	1	200	4	3	2,400	
3460 to 3570	1	110	3	3	990	
3570 to 3770	1	200	$3\frac{1}{2}$	3	2,100	
3770 to 4370	1	600	4	3	7,200	
4370 to 4770	1	400	$3\frac{1}{2}$	3	4,200	
4770 to 5320	1	550	3	3	4,950	
5320 to 5870	1	550	$2\frac{1}{2}$	3	1,375	
					31,960	
Deduct.—						
Sluice No. 2.	1	9	4	3	108	
						31,852 c.ft.

Detail of work.	No.	Measurements. L.	B.	H.	Quantities.
Concrete in Superstructure.—					
From chainage No. 2470 to 5870	1	3400	2	4	27,200
	1	2850	$2\frac{1}{2}$	3	21,375
	1	2140	3	3	19,260
	1	1510	$3\frac{1}{2}$	3	15,855
	1	660	4	3	7,920
	1	500	$4\frac{1}{2}$	3	6,650
	1	470	5	3	7,050
	1	440	$5\frac{1}{2}$	3	7,260
	1	240	6	3	4,320
2720 to 2760	1	40	6	1	240
2720 to 2760	1	40	6	2	480
					1,17,610 c.ft.
(*b*) *Earthwork.*—					
C.S. No.					
A to B from chain No.—					
2470 to 2770 0 to 4	1	298	$\frac{28 + 2456}{2}$		3,70,116
2770 to 2870 4	1	100	2456		2,45,600
2870 to 3100 4 to 5	1	230	$\frac{2456 + 1671}{2}$		4,05,605
3100 to 3270 5 to 6	1	170	$\frac{1671 + 615}{2}$		1,94,310
3270 to 3400 6	1	130	615		79,950
3400 to 3460 6 to 0	1	60	615		18,450
3480 to 3570 0 to 7	1	90	$\frac{0 + 297}{2}$		13,365
3570 to 3970 7 to 8	1	400	$\frac{257 + 538}{2}$		1,67,000
3970 to 4170 8	1	200	538		53,800
4170 to 4870 8 to 9	1	700	$\frac{538 + 233}{2}$		2,69,850
4870 to 5770 9 to 10	1	900	$\frac{233 + 93}{2}$		1,46,700
5770 to 5850 10 to 0	1	80	93		3,720
					19,68,466
Deduct.—					
Sluice No. 2.	1	$37\frac{1}{2}$	11	$\frac{11}{2}$	2,269
					19,66,197 c.ft
(*c*) *Dry Stone Pitching.*—					
From chain No. 2472 to 2750	1	275	$\frac{0 + 85\frac{1}{2}}{2}$		11,756
2750 to 2870	1	120	$85\frac{1}{2}$		5,130
2870 to 3100	1	230	$\frac{85\frac{1}{2} + 69}{2}$		17,767
3100 to 3270	1	170	$\frac{69 + 38}{2}$		13,388
3270 to 3400	1	130	38		4,940
3400 to 3450	1	50	$\frac{38 + 0}{2}$		950
3450 to 3570	1	70	$\frac{0 + 22\frac{1}{2}}{2}$		788

Detail of work.	No.	Measurements. L.	B.	H.	Quantities.
Dry Stone Pitching (contd.)—					
From chain No. 3570 to 3970	1	400	$\frac{22\frac{1}{2} + 34}{2}$		11,300
3970 to 4170	1	200	34		6,800
4170 to 4870	1	700	$\frac{34 + 19}{2}$		18,550
4870 to 5770	1	900	$\frac{19 + 8}{2}$		12,150
5770 to 5820	1	500	$\frac{8 + 0}{2}$		200
Lower top of dam 2472 to 5820	1	3348	5		16,740
					1,20,459
Deduct.—					
Sluice No. 2.	1	0	40		360
					1,20,099 c.ft.
II.—WEIRS.					
(A) Weir No. 1					
Hard rock-cutting.—		mean.			
From chain No. 95 to 160	1	65	50	6	19,500
170 to 210	1	40	40	4	4,600
For masonry	1	110	3	2	660
„	1	55	3	$3\frac{1}{2}$	413
					25,173 c.ft.
Masonry stone in lime.—					
1st Step.	1	55	3	2	330
2nd „	1	110	3	1	330
3rd „	1	110	$\frac{2\frac{1}{2} + 2}{2}$	2	495
					1,155 c.ft.
(B) Weir No. 2.					
Hard rock-cutting.—			areas.		
For weir	1	120	$\frac{459 + 3614}{2}$		2,44,280
„ „	1	140	$\frac{3614 + 819}{2}$		5,90,310
„ wing wall	1	44	$2\frac{1}{2}$	3	330
					8,34,920 c.ft.
Masonry stone in lime.—					
Wing wall, 1st Step.	1	44	$2\frac{1}{2}$	3	330
2nd „	1	44	2	4	352
3rd „	1	$\frac{10 + 18}{2}$	2	2	56
					738 c.ft.

Detail of work.	No.	Measurements. L.	B.	H.	Quantities.	
III.—SLUICES.						
(A) Sluice No. 1.						
Rock cutting for foundation.—		area.				
Well	1	85	...	2	170	
Wall of well all round ...	1	20	$4\frac{1}{2}$	4	360	
Inlet channel wing walls ...	2	10	$4\frac{1}{2}$	4	360	
„ ...	1	10	$1\frac{1}{2}$	2	30	
Outlet channel wing walls ...	2	70	$2\frac{1}{2}$	$3\frac{1}{2}$	1,225	
„ „ flooring ...	1	70	$1\frac{1}{2}$	$2\frac{1}{2}$	263	
						2,408 c.ft.
Masonry stone and lime in foundation.—		mean.				
Well all round ...	1	20	$4\frac{1}{2}$	$\frac{2+6}{2}$	360	
		area.				
„ floor ...	1	85	...	2	170	
Inlet channel wing wall ...	1	11	$4\frac{1}{2}$	$2\frac{1}{2}$	112	
„ „ ...	1	11	$4\frac{1}{2}$	4	198	
„ flooring ...	1	10	$2\frac{1}{2}$	2	50	
Outlet channel ...	1	70	$2\frac{1}{2}$	$2\frac{1}{2}$	437	
„ ...	1	70	$2\frac{1}{2}$	4	700	
Face wall ...	1	$6\frac{1}{2}$	3	5	98	
Flooring ...	1	70	$1\frac{1}{2}$	$2\frac{1}{2}$	263	
						2,388 c.ft.
Masonry stone and lime in superstructure.—						
Well all round ...	2	$10\frac{1}{2}$	$\frac{4+2}{2} \times 28$		1,760	
		mean.				
Inlet channel ...	2	$10\frac{1}{4}$	$\frac{4\,2+}{2} \times 27$		1,660	
Outlet „ ...	2	$64\frac{1}{2}$	2	2	516	
„ open wing wall ...	2	10	$\frac{2+1\frac{1}{2}}{2} \times 4$		140	
„ face wall ...	1	6	2	2	24	
„ wall above lintel ...	1	2	$\frac{2+2\frac{1}{2}}{2} \times 4$		18	
		mean.				
Raising parapet wall all round.	1	61	2	1	122	
						4,240 c.ft.
Arch masonry ...	1	66	$5\frac{1}{2}$	$1\frac{1}{2}$	545	
						545 c.ft.
Cut stone work.—						
Stone slab for plug holes, 4″ thick	1	3	$\frac{1}{3}$	24	24	
„ lintel ...	1	3	$2\frac{1}{2}$	$\frac{1}{3}$	2 50	
„ over brackets for rod.	3	$4\frac{1}{2}$	2	$\frac{1}{4}$	6·75	
„ Brackets ...	3	4	$1\frac{1}{2}$	$\frac{1}{4}$	4·50	
		mean.				
„ Coping all round ...	1	61	3	$\frac{1}{4}$	45·75	
„ Brackets below coping	14	$1\frac{1}{2}$	1	$\frac{1}{6}$	3·50	
„ grooved stones for planks.	6	1	$\frac{1}{2}$	29	87·00	
„ „ „ for grating.	2	1	$\frac{1}{2}$	24	24	
						198 c.ft
Cast iron sluice gate, 9″ diameter.	1	...	...	...		1 No.
„ pipe, 9″ diameter ...	1	6	...	...	6	
						6 ft.

Detail of work.	No.	Measurements. L.	B.	H.	Quantities.	
Iron work.—					lbs.	
Iron bar, 1″ diameter, for ladder.	36	4	...	...	144	
,, for sluices.	1	30	...	...	30	
					$\frac{174 \times 2{\cdot}62}{112}$	=4 cwt.
Iron grating complete with 1/16.— mesh gauze and frame ...	1	$2\frac{1}{2}$	...	27	67	67 s.ft.
Wood-work.— Plank shutters ($2\frac{1}{2}$″ thick) ...	2	$2\frac{1}{2}$	...	27	135	135 s.ft.
Iron railing, complete with 2″ diameter.— Stand posts and two lines of wire as shown in the detail plan ...	1	mean. 64	...	...	...	64 r.ft.
Iron pulley for rod, 9″ diameter ...	1	...	...	...	...	1 No.
(B) Sluice No. 2.						
Excavation for foundation.— (area 133—33 s.ft. area of core wall=80)	1	80	...	7	560	
Inlet channel wings ...	1	11	11	7	847	
,, ...	2	24	$\frac{4 + 2\frac{1}{2}}{2}$	4	624	
Outlet channel wings ...	2	46	3	4	1,184	
,, ,, flooring ...	1	46	$\frac{1}{2}$	2	46	
Inlet ,, ,, ...	1	24	$\frac{7 + 2}{2}$	mean. 2	216	3,477 c.ft.
Concrete in foundation.— Well	1	80	...	3	240	
Inlet wing wall ...	1	11	11	3	363	
,, ,, ...	2	25	$4 \times 2\frac{1}{2}$	2	325	
,, flooring	1	25	$\frac{7 + 2}{2}$	1	113	
Outlet channel wing wall ...	2	47	3	2	564	
,, ,, flooring ...	1	47	1	1	47	1,652 c.ft.
Masonry stone and lime in foundation.— Well	1	area. 80	...	4	320	
Inlet channel wing ...	1	11	11	4	484	
,, ,, ...	2	25	mean. $3\frac{1}{4}$	2	325	
,, ,, flooring ...	1	25	$\frac{7 + 2}{2}$	1	113	
Outlet ,, wings ...	2	46	$2\frac{1}{2}$	2	460	
,, ,, flooring ...	1	47	$1\frac{1}{2}$	1	70	1,772 c.ft.

Detail of work.	No.	Measurements. L.	B.	H.	Quantities.	
Stone and lime masonry superstructure—						
Wall all round ...	2	11	$\frac{3\frac{3}{4}+2}{2}$	18	1,138	
Inlet channel ...	2	10	$\frac{3\frac{3}{4}+2}{2}$	17	978	
„ „	2	$\frac{29+0}{2}$	$\frac{3\frac{3}{4}+2}{2}$	17	1,835	
Outlet „ ...	2	$40\frac{1}{2}$	2	2	324	
„ „ open ...	2	6	2	$\frac{2+6}{2}$	96	
„ „ face wall ...	1	6	2	4	48	
Above lintel	1	2	$\frac{2+2\frac{1}{2}}{2}$	4	18	
Raising parapet around the well...	1	61	2	1	122	
						4,559 c.ft.
Arch work.—						
Cut stone work.—						
Stone slab for plug holes ...	1	3	$\frac{1}{3}$	14	14	
„ lintel ...	1	3	$2\frac{1}{2}$	$\frac{1}{3}$	2·50	
„ above brackets for rod.	2	$4\frac{1}{2}$	$1\frac{1}{2}$	$\frac{1}{3}$	4·50	
„ Brackets ...	2	4	$1\frac{1}{2}$	$\frac{1}{4}$	3·00	
„ groove stone for wooden plank	6	1	$\frac{1}{2}$	19	57·00	
„ „ „ grating.	2	1	$\frac{1}{2}$	14	14·00	
„ coping around the well.	1	61	3	$\frac{1}{4}$	45·75	
„ Brackets outside the coping	14	$1\frac{1}{2}$	1	$\frac{1}{6}$	3·50	
						144 c.ft.
Cast iron sluice gate, 18″ diameter.	1	...	...	...	...	1 No.
„ pipe, 18″ diameter ...	1	6	...	...	...	6 r.ft.
Iron work.—					lbs.	
Iron bar for ladder, 1″ diameter ...	11×2	4	=88 × 2·6		229	
Rod for sluice, $1\frac{1}{4}$″ diameter ...	1	23 by 5·9	...		=136	
					365	
					112	=3·8 cwt.
Wood work.—						
Wooden planks, $2\frac{1}{2}$″ thick	2	$2\frac{1}{2}$	...	17	85	85 s.ft.
Iron grating	1	$2\frac{1}{2}$	...	17	42	42 s.ft.
Iron Pulley for rod, 9″ diameter.	1	...	...	...	...	1 No.
IV.—IRRIGATION CHANNELS.						
(A) Channel for Sluice No. 1.						
Earthwork cutting ...	1	7200	$\frac{5\frac{1}{2}+2}{2}$	$1\frac{3}{4}$	47,250	
						47,250 c.ft.
Aqueduct	1	...	...	...	1 No.	1 No.

Detail of work.	No.	Measurements.			Quantities.
		L.	B.	H.	
(B) *Channel for Sluice No. 2.*					
Earthwork.—	1				
Cutting channel main ...		2800	$\frac{11+3}{2}$	4	39,200
„ „ No. 1 ...	1	13000	$\frac{9+3}{2}$	3	2,34,000
„ „ No. 2 ...	1	15400	$\frac{8+3}{2}$	$2\frac{1}{2}$	2,11,750
„ „ No. 3 ...	1	6400	$\frac{5\frac{1}{3}+2}{2}$	$1\frac{3}{4}$	42,000 c.ft. 5,26,950

ABSTRACT.

Quantitty or No.	Abstract of expense.	Rate.	Per.	Amount.	Total.
	(1) DAM.	Rs. A.	Rs.	Rs.	Rs.
	(A) Dam No. 1.				
	(*a*) *Face wall.*				
1,860 c.ft.	Rock-cutting for foundation ...	3	%	56	
9,100 „	Concrete in foundation ...	10	„	910	
72,459 „	Masonry stone and Lime ...	16	„	11,593	
23,800 „	Removing silt and boulders from the bed of nullah rear side.	1	„	238	
4,00,305 „	(*b*) Earthwork	5	0/00	2,002	
					14,799
	(B) Dam No. 2.				
	(*a*) *Core wall.*				
5,400 „	Rock-cutting for foundation ...	3	%	162	
31,852 „	Concrete in foundation ...	10	„	3,185	
1,17,610 „	„ superstructure ...	10	„	11,761	
19,66,197 „	(*b*) Earthwork	5	0/00	9,831	
1,20,099 „	(*c*) Dry stone pitching ...	3	%	3,603	
					28,542
					43,341
	(2) WEIR.				
	(A) Weir No. 1.				
25,173 „	Rock-cutting	3	„	755	
1,155 „	Masonry stone and Lime ...	16	„	185	
					940
	(B) Weir No. 2				
8,34,920 „	Rock-cutting	3	„	25,048	
738 „	Masonry Stone and Lime ...	16	„	118	
					25,166
					26,106
	(3) SLUICES.				
	(A) Sluice No. 1.				
2,408 „	Rock-cutting	3	„	72	
2,388 „	Masonry stone lime in foundation.	14	„	334	
4,240 „	Do. in superstructure	16	„	678	
545 „	Arch masonry	20	„	109	
198 „	Cut stone work	1	c.ft.	198	
1 No.	Cast iron sluice gate, 9″ ...	100	Each	100	
6 r.ft.	Do. do pipe, 9″ ...	Lump sum		25	
4 cwt	Iron work	8 0	Cwt.	32	
67 s.ft.	Iron grating	0 8	s.ft.	33	
135 „	Wood work	0 8	„	68	
64 r.ft.	Iron Railing, complete ...	0 8	r.ft.	32	
1 No.	Iron Pulley, 9″ dia., for rod of sluice No. 1 (hand wheel).	7 0	Each	7	1,688
	Carried over ...				1,688

Quantitty or No.		Abstract of expense.	Rate.		Per.	Amount.	Total.
			Rs.	A.	Rs.	Rs.	Rs.
		Brought forward ...					1,688
		(B) Sluice No. 2.					
3,477	c.ft.	Excavation for foundation (Excavated earth to be used for embankment).					
1,052	,,	Concrete in foundation ...	1		%	348	
1,772	,,	Masonry stone and lime in foundation.	14		,,	248	
4,549	,,	Do. do. in superstructure	16		,,	728	
342	,,	Archwork	20		,,	68	
144	,,	Cut stone work	1		c.ft.	144	
1	No.	Cast iron sluice gate, 18" ...	360		Each	360	
6	r.ft.	Do pipe, 18" ...	90		,,	90	
3·8	cwt	Iron work	8		Cwt	30	
85	s.ft.	Wood work	0	8	s.ft.	43	
42	,,	Iron grating	0	8	,,	21	
1	No.	Iron Pulley for rod of sluice No. 2, 9" diameter	7		Each	7	
							2,087
		(4) IRRIGATION CHANNELS.					3,775
		(A) Channel for Sluice No. 1.					
47,250	c.ft.	Earthwork (cutting)	5		0/00	236	
1	No.	Aqueduct	300		Each	300	
							536
		(B) Channel for Sluice No. 2.					
5,26,950	c.ft	Earthwork	5		0/00	2,635	
							2,635
							3,171

Quantitty or No.	Abstract of expense.	Rate.	Per.	Amount.	Total.
	GENERAL ABSTRACT.				
	(1) DAM.				
	(A) Dam No. 1	... ...	...	14,799	
	(B) Dam No. 2	... ...	...	28,542	
	(2) WEIRS.				43,341
	(A) Weir No. 1	... ...	...	940	
	(B) Weir No. 2	... ...	...	25,166	
	(3) SLUICES.				26,106
	(A) Sluice No. 1	... ...	...	1,688	
	(B) Sluice No. 2	... ...	...	2,087	
	(4) IRRIGATION CHANNELS.				3,775
	(A) Channel for Sluice No. 1 ...	... ...	...	536	
	(B) ,, ,, No. 2 . .	... ...	...	2,635	
					3,171
					76,393
	Add Contingencies	5 ...	p.c.	...	3,820
	Total ...	... ...	...	...	80,213

F. St. G. MANNERS-SMITH,

Superintending Engineer,

Dated Abu, September 1907. *Public Works Department, Rajputana.*